

WHAT IS CLAIMED IS:

1. A method of forming a uniform nitride dielectric layer over a nitride resistive material and a nitride receptive material, the method comprising the steps of:
implanting a surface-modifying agent into exposed surfaces of the nitride resistive material;
forming the nitride dielectric layer on the nitride resistive material and the nitride receptive material, whereby the surface-modifying agent provides for formation of a uniform thickness of the nitride dielectric layer over the nitride resistive material and the nitride receptive material.
2. The method of Claim 1, wherein the surface-modifying agent comprises an ionizable nitrogen or silicon material.
3. The method of Claim 2, wherein the surface-modifying agent comprises a nitrogen-containing gas.
4. The method of Claim 3, wherein the nitrogen-containing gas is selected from the group consisting of trifluoronitride, nitrogen, ammonia, nitrous oxide, and nitric oxide.
5. The method of Claim 3, wherein the nitrogen-containing gas comprises trifluoronitride.
6. The method of Claim 2, wherein the surface-modifying agent comprises a silicon-containing gas.
7. The method of Claim 6, wherein the silicon-containing gas is selected from the group consisting of silicon tetrafluoride, silane, dichlorosilane, trichlorosilane, and silicon tetrachloride.
8. The method of Claim 6, wherein the silicon-containing gas comprises silicon tetrafluoride.
9. The method of Claim 1, wherein the surface-modifying agent is implanted by low angle implantation.
10. The method of Claim 9, wherein the surface-modifying agent is implanted at an angle of about 60° to about 85° from vertical.

11. The method of Claim 1, wherein the surface-modifying agent is implanted into the nitride resistive material at a dose amount of about 10^{12} to about 10^{22} atoms/cm³.
12. The method of Claim 1, wherein the nitride resistive material comprises an insulative material.
13. The method of Claim 12, wherein the insulative material is selected from the group consisting of silicon dioxide, phosphosilicate glass, borosilicate glass, and borophosphosilicate glass.
14. The method of Claim 12, wherein the insulative material comprises borophosphosilicate glass.
15. The method of Claim 1, wherein the nitride receptive material comprises a semiconductive material.
16. The method of Claim 15, wherein the semiconductive material comprises polysilicon or hemispherical grain silicon.
17. The method of Claim 15, wherein the semiconductive material comprises hemispherical grain silicon.
18. The method of Claim 1, wherein the nitride receptive material comprises a conductive material.
19. The method of Claim 18, wherein the conductive material comprises a conductive metal.
20. A method of forming a uniform nitride dielectric layer over a nitride resistive material and a nitride receptive material, the method comprising the steps of:
implanting a surface-modifying agent comprising an ionizable nitrogen material into the nitride resistive material; and

forming the nitride dielectric layer on the nitride resistive material and the nitride receptive material, whereby the implanted surface-modifying agent provides for formation of a uniform thickness of the nitride dielectric layer over the nitride resistive material and the nitride receptive material.

21. The method of Claim 20, wherein the surface-modifying agent comprises a nitrogen-containing gas selected from the group consisting of trifluoronitride, nitrogen, ammonia, nitrous oxide, and nitric oxide.

22. The method of Claim 20, wherein the nitride resistive material comprises an insulative material.

23. The method of Claim 20, wherein the nitride receptive material comprises a semiconductive material.

24. The method of Claim 20, wherein the nitride receptive material comprises a conductive material.

25. A method of forming a uniform nitride dielectric layer over a nitride resistive material and a nitride receptive material, the method comprising the steps of:

implanting a surface-modifying agent comprising an ionizable silicon material into the nitride resistive material; and

forming the nitride dielectric layer on the nitride resistive material and the nitride receptive material, whereby the implanted surface-modifying agent provides for formation of a uniform thickness of the nitride dielectric layer over the nitride resistive material and the nitride receptive material.

26. The method of Claim 25, wherein the surface-modifying agent comprises a silicon-containing gas selected from the group consisting of silicon tetrafluoride, silane, dichlorosilane, trichlorosilane, and silicon tetrachloride.

27. The method of Claim 25, wherein the nitride resistive material comprises an insulative material.

28. The method of Claim 25, wherein the nitride receptive material comprises a semiconductive material.

29. The method of Claim 25, wherein the nitride receptive material comprises a conductive material.

30. A method of forming a uniform dielectric layer over a substrate comprising adjacent portions of an insulative material and a semiconductive material, the method comprising the steps of:

implanting a surface-modifying agent comprising a nitrogen-containing gas or a silicon-containing gas into the insulative material; and

forming the dielectric layer on the insulative material and the semiconductive material, whereby the implanted surface-modifying agent provides for formation of a uniform thickness of the dielectric layer over the insulative material and the semiconductive material of the substrate.

31. The method of Claim 30, wherein the surface-modifying agent comprises a nitrogen-containing gas selected from the group consisting of trifluoronitride, nitrogen, ammonia, nitrous oxide, and nitric oxide.

32. The method of Claim 30, wherein the surface-modifying agent comprises a silicon-containing gas selected from the group consisting of silicon tetrafluoride, silane, dichlorosilane, trichlorosilane, and silicon tetrachloride.

33. A method of forming a uniform dielectric layer over a substrate comprising adjacent portions of an insulative material and a conductive material, the method comprising the steps of:

implanting a surface-modifying agent comprising a nitrogen-containing gas or a silicon-containing gas into the insulative material; and

forming the dielectric layer on the insulative material and the conductive material, whereby the implanted surface-modifying agent provides for formation of a uniform thickness of the dielectric layer over the insulative material and the conductive material of the substrate.

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34. The method of Claim 33, wherein the surface-modifying agent comprises a nitrogen-containing gas selected from the group consisting of trifluoronitride, nitrogen, ammonia, nitrous oxide, and nitric oxide.
35. The method of Claim 33, wherein the surface-modifying agent comprises a silicon gas selected from the group consisting of silicon tetrafluoride, silane, dichlorosilane, trichlorosilane, and silicon tetrachloride.
36. A method of forming a nitride dielectric layer in a capacitor container in a semiconductor substrate, the capacitor container comprising an opening formed in a layer comprising a nitride resistive material, and a lower electrode comprising a nitride receptive material formed within the container opening; the method comprising the steps of:
- implanting a surface-modifying agent by low angle implantation into exposed surfaces of the nitride resistive material layer; and
 - forming the nitride dielectric layer over the nitride resistive material layer and the lower electrode, whereby the surface-modifying agent provides for formation of a uniform thickness of the nitride dielectric layer over the nitride resistive material layer and the lower electrode.
37. The method of Claim 36, wherein the surface-modifying agent is implanted into the nitride resistive material layer within the container opening and at corners of the container opening.
38. The method of Claim 36, wherein the surface-modifying agent is implanted at an angle of about 60° to about 85° from vertical.
39. The method of Claim 36, wherein the step of implanting the surface-modifying agent further comprises rotating the semiconductor substrate during the implantation.
40. The method of Claim 36, wherein the surface-modifying agent is implanted into the nitride resistive material layer at a dose amount of about 10^{12} to about 10^{22} atoms/cm³.

41. The method of Claim 36, wherein the surface-modifying agent comprises a nitrogen-containing gas.
42. The method of Claim 41, wherein the nitrogen-containing gas is selected from the group consisting of trifluoronitride, nitrogen, ammonia, nitrous oxide, and nitric oxide.
43. The method of Claim 41, wherein the surface-modifying agent comprises trifluoronitride.
44. The method of Claim 36, wherein the surface-modifying agent comprises a silicon-containing gas.
45. The method of Claim 44, wherein silicon-containing gas is selected from the group consisting of silicon tetrafluoride, silane, dichlorosilane, trichlorosilane, and silicon tetrachloride.
46. The method of Claim 44, wherein the surface-modifying agent comprises silicon tetrafluoride.
47. The method of Claim 36, wherein the nitride resistive material comprises an insulative material.
48. The method of Claim 47, wherein the insulative material is selected from the group consisting of silicon dioxide, phosphosilicate glass, borosilicate glass, and borophosphosilicate glass.
49. The method of Claim 47, wherein the insulation layer comprises borophosphosilicate glass.
50. The method of Claim 36, wherein the nitride receptive material comprises a semiconductive material.
51. The method of Claim 50, wherein the semiconductive material is selected from the group consisting of polysilicon and hemispherical grain silicon.

52. The method of Claim 50, wherein the semiconductive material comprises hemispherical grain silicon.

53. The method of Claim 36, wherein the nitride receptive material comprises a conductive material.

54. The method of Claim 53, wherein the conductive material comprises a conductive metal.

55. A method of forming a nitride dielectric layer in a capacitor container in a semiconductor substrate, the capacitor container comprising an opening formed in a layer comprising a nitride resistive material, and a lower electrode comprising a nitride receptive material formed within the container opening; the method comprising the steps of:

while rotating the semiconductor substrate, implanting a surface-modifying agent by low angle implantation into exposed surfaces of the nitride resistive material layer within the container opening and at corners of the container opening; and

forming the nitride dielectric layer over the nitride resistive material layer and the lower electrode, whereby the surface-modifying agent provides for formation of a uniform thickness of the nitride dielectric layer over the nitride resistive material layer and the lower electrode.

56. The method of Claim 55, wherein the surface-modifying agent is implanted at an angle of about 60° to about 85° from vertical.

57. The method of Claim 55, wherein the surface-modifying agent is implanted into the nitride resistive material layer at a dose amount of about 10^{12} to about 10^{22} atoms/cm³.

58. The method of Claim 55, wherein the surface-modifying agent comprises a nitrogen-containing gas selected from the group consisting of trifluoronitride, nitrogen, ammonia, nitrous oxide, and nitric oxide.

59. The method of Claim 55, wherein the surface-modifying agent comprises a silicon-containing gas selected from the group consisting of silicon tetrafluoride, silane, dichlorosilane, trichlorosilane, and silicon tetrachloride.

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forming the nitride dielectric layer over the insulation layer and the lower electrode, whereby the implanted surface-modifying agent provides for formation of a uniform thickness of the nitride dielectric layer over the insulation layer and the lower electrode.

67. The method of Claim 66, wherein the silicon-containing gas is selected from the group consisting of silicon tetrafluoride, silan, dichlorosilane, trichlorosilane, and silicon tetrachloride.

68. The method of Claim 66, wherein the surface-modifying agent is implanted at an angle of about 60° to about 85° from vertical.

69. The method of Claim 66, wherein the step of implanting the surface-modifying agent species further comprises rotating the semiconductor substrate during the implantation.

70. The method of Claim 66, wherein the surface-modifying agent is implanted into the insulation layer exposed within the container opening and at corners of the container opening.

71. The method of Claim 66, wherein the surface-modifying agent is implanted into the insulation layer at a dose amount of about 10^{12} to about 10^{22} atoms/cm³.

72. A method of forming a capacitor in a semiconductor device, comprising the steps of:
providing a substrate comprising an nitride resistive material layer overlying the substrate, a container opening formed in the nitride resistive material layer; and a lower electrode comprising a nitride receptive material formed within the container opening; the method comprising the steps of:
implanting a surface-modifying agent by low angle implantation into exposed surfaces of the nitride resistive material layer; and

forming a nitride dielectric layer over the nitride resistive material layer and the lower electrode, whereby the surface-modifying agent provides for formation of a uniform thickness of the nitride dielectric layer over the nitride resistive material layer and the lower electrode.

73. The method of Claim 72, wherein the surface-modifying agent is implanted at an angle of about 60° to about 85° from vertical.

74. The method of Claim 72, wherein the surface-modifying agent is implanted into the nitride resistive material layer within the container opening and at upper corners of the container opening.
75. The method of Claim 72, wherein the step of implanting the surface-modifying agent further comprises rotating the semiconductor substrate during the implantation.
76. The method of Claim 72, wherein the surface-modifying agent comprises a nitrogen-containing gas selected from the group consisting of trifluoronitride, nitrogen, ammonia, nitrous oxide, and nitric oxide.
77. The method of Claim 72, wherein the surface-modifying agent comprises a silicon-containing gas selected from the group consisting of silicon tetrafluoride, silane, dichlorosilane, trichlorosilane, and silicon tetrachloride.
78. The method of Claim 72, wherein the nitride resistive material layer comprises an insulative material, and the lower electrode comprises a semiconductive material.
79. The method of Claim 72, wherein the nitride resistive material layer comprises an insulative material, and the lower electrode comprises a conductive material.
80. The method of Claim 72, further comprising, after the step of forming the dielectric layer, forming an upper electrode over the nitride layer.
81. A method of forming a capacitor in a semiconductor device, comprising the steps of:
providing a substrate comprising a nitride resistive material layer overlying the substrate, a container opening formed in the nitride resistive material layer; and a lower electrode formed within the container opening; the method comprising the steps of:
while rotating the semiconductor device, implanting a surface-modifying agent by low angle implantation into exposed surfaces of the nitride resistive material layer to implant said agent into the nitride resistive material layer within the container opening and at upper corners of the container opening; and

forming a nitride dielectric layer over the nitride resistive material layer and the lower electrode, whereby the surface-modifying agent provides for formation of a uniform thickness of the nitride dielectric layer over the nitride resistive material layer and the lower electrode.

82. The method of Claim 81, wherein the surface-modifying agent is implanted at an angle of about 60° to about 85° from vertical.

83. The method of Claim 81, wherein the surface-modifying agent comprises a nitrogen-containing gas selected from the group consisting of trifluoronitride, nitrogen, ammonia, nitrous oxide, and nitric oxide.

84. The method of Claim 81, wherein the surface-modifying agent comprises a silicon-containing gas selected from the group consisting of silicon tetrafluoride, silane, dichlorosilane, trichlorosilane, and silicon tetrachloride.

85. The method of Claim 81, wherein the nitride resistive material layer comprises an insulative material, and the lower electrode comprises a semiconductive material.

86. The method of Claim 81, wherein the nitride resistive material layer comprises an insulative material, and the lower electrode comprises a conductive material.

87. A method of forming a capacitor in a semiconductor device, comprising the steps of:
providing a substrate comprising an insulation layer overlying the substrate, a container opening formed in the insulation layer; and a lower electrode formed within the container opening;
the method comprising the steps of:

while rotating the semiconductor device, implanting a surface-modifying agent by low angle implantation at an angle of about 60° to about 85° from vertical into exposed surfaces of the insulation layer to implant said agent into the insulation layer within the container opening and at upper corners of the container opening; and

forming a nitride dielectric layer over the insulation layer and the lower electrode, whereby the surface-modifying agent provides for formation of a uniform thickness of the nitride dielectric layer over the insulation layer and the lower electrode.

88. The method of Claim 87, wherein the surface-modifying agent comprises a nitrogen-containing gas selected from the group consisting of trifluoronitride, nitrogen, ammonia, nitrous oxide, and nitric oxide.

89. The method of Claim 87, wherein the surface-modifying agent comprises a silicon-containing gas selected from the group consisting of silicon tetrafluoride, silane, dichlorosilane, trichlorosilane, and silicon tetrachloride.

90. The method of Claim 87, wherein the lower electrode comprises a semiconductive material.

91. The method of Claim 87, wherein the lower electrode comprises a conductive material.

92. A capacitor, comprising:

a container formed in an nitride resistive material layer, the container comprising side walls and a top corner portion; and a lower capacitor electrode formed in the container and overlying the nitride resistive material layer; a portion of the nitride resistive material layer being exposed at the top corner portion of the container, said exposed portion of the nitride resistive material layer comprising an implanted surface-modifying agent, whereby the surface-modifying agent provides for formation of a uniform thickness of a dielectric layer over the nitride resistive material layer and the lower capacitor electrode;

a dielectric layer overlying the lower capacitor electrode and the nitride resistive material layer; the dielectric layer having a uniform thickness over the lower capacitor electrode and the nitride resistive material layer; and

an upper capacitor plate overlying the dielectric layer.

93. The capacitor of Claim 92, wherein the surface-modifying agent comprises a nitrogen-containing gas selected from the group consisting of trifluoronitride, nitrogen, ammonia, nitrous oxide, and nitric oxide.

94. The capacitor of claim 92, wherein the surface-modifying agent comprises trifluoronitride.

95. The capacitor of Claim 92, wherein the surface-modifying agent comprises a silicon-containing gas selected from the group consisting of silicon tetrafluoride, silane, dichlorosilane, trichlorosilane, and silicon tetrachloride.

96. The capacitor of Claim 92, wherein the surface-modifying agent comprises silicon tetrafluoride.

97. The capacitor of Claim 92, wherein the nitride resistive material layer comprises an insulative material, and the lower electrode comprises a semiconductive material..

98. The capacitor of Claim 92, wherein the nitride resistive material layer comprises an insulative material and the lower electrode comprises a conductive material.

99. The capacitor of Claim 92, wherein the capacitor is integrated into a DRAM cell.

100. A capacitor, comprising:

a container formed in a nitride resistive material layer, the container comprising side walls and a top corner portion; and a lower capacitor electrode formed in the container and overlying the nitride resistive layer; a portion of the nitride resistive material layer being exposed at the top corner portion of the container, said exposed portion of the nitride resistive material layer implanted with a surface-modifying agent comprising an ionizable nitrogen species, whereby the implanted surface-modifying agent provides for formation of a uniform thickness of a dielectric layer over the nitride resistive material layer and the lower capacitor electrode;

a dielectric layer overlying the lower capacitor electrode and the nitride resistive material layer; the dielectric layer having a uniform thickness over the lower capacitor electrode and the nitride resistive material layer; and

an upper capacitor plate overlying the dielectric layer.

101. The capacitor of Claim 100, wherein the surface-modifying agent comprises a nitrogen-containing gas selected from the group consisting of trifluoronitride, nitrogen, ammonia, nitrous oxide, and nitric oxide.

102. The capacitor of Claim 100, wherein the nitride resistive material layer comprises about 10^{12} to about 10^{22} atoms/cm³ of the surface-modifying agent.

103. The capacitor of Claim 100, wherein the nitride resistive material comprises an insulative material and the lower electrode comprises a semiconductive material.

104. The capacitor of Claim 100, wherein the nitride resistive material comprises an insulative material and the lower electrode comprises a conductive material.

105. A capacitor, comprising:

a container formed in a nitride resistive material layer, the container comprising side walls and a top corner portion; and a lower capacitor electrode formed in the container and overlying the nitride resistive material layer; a portion of the nitride resistive material layer being exposed at the top corner portion of the container, said exposed portion of the nitride resistive material layer implanted with a surface-modifying agent comprising an ionizable silicon species, whereby the surface-modifying agent provides for formation of a uniform thickness of a dielectric layer over the nitride resistive material layer and the lower capacitor electrode;

a dielectric layer overlying the lower capacitor electrode and the insulation layer; the dielectric layer having a uniform thickness over the lower capacitor electrode and the nitride resistive material layer; and

an upper capacitor plate overlying the dielectric layer.

106. The capacitor of Claim 105, wherein the surface-modifying agent comprises a silicon-containing gas selected from the group consisting of silicon tetrafluoride, silane, dichlorosilane, trichlorosilane, and silicon tetrachloride.

107. The capacitor of Claim 105, wherein the nitride resistive material layer comprises about 10^{12} to about 10^{22} atoms/cm³ of the surface-modifying agent.

108. The capacitor of Claim 105, wherein the nitride resistive material layer comprises an insulative material and the lower electrode comprises a conductive material.

109. The capacitor of Claim 105, wherein the nitride resistive material layer comprises an insulative material and the lower electrode comprises a semiconductive material..

110. A semiconductor circuit, comprising a capacitor;

the capacitor comprising a dielectric nitride layer interposed between a lower electrode and an upper electrode, the lower electrode formed in a container comprising an nitride resistive material layer and a top corner portion, a portion of the nitride resistive material layer being exposed at the top corner portion of the container, said exposed portion of the nitride resistive material layer implanted with a surface-modifying agent, whereby the surface-modifying agent provides for formation of a uniform thickness of a dielectric layer over the nitride resistive material layer and the lower capacitor electrode; and the dielectric layer having a uniform thickness over the lower capacitor electrode and the nitride resistive material layer.

111. The semiconductor circuit of Claim 110, wherein the surface-modifying agent comprises a nitrogen-containing gas selected from the group consisting of trifluoronitride, nitrogen, ammonia, nitrous oxide, and nitric oxide.

112. The semiconductor circuit of Claim 110, wherein the surface-modifying agent comprises a silicon-containing gas selected from the group consisting of silicon tetrafluoride, silane, dichlorosilane, trichlorosilane, and silicon tetrachloride.

113. The semiconductor circuit of Claim 110, wherein the nitride resistive material comprises about 10^{12} to 10^{22} atoms/cm³ of the surface-modifying agent.

114. The semiconductor circuit of Claim 110, wherein the nitride resistive material layer comprises an insulative material, and lower electrode comprises a semiconductive material.

115. The semiconductor circuit of Claim 110, wherein the nitride resistive material layer comprises an insulative material, and the lower electrode comprises a conductive material.

116. A semiconductor circuit, comprising a capacitor;

the capacitor comprising a nitride dielectric layer interposed between a lower electrode and an upper electrode, the lower electrode formed in a container comprising an insulation layer and a top corner portion, a portion of the insulation layer being exposed at the top corner portion of the container, said exposed portion of the insulation layer implanted with a surface-modifying agent comprising an ionizable nitrogen species, whereby the surface-modifying agent provides for formation of a uniform thickness of a dielectric layer over the insulation layer and the lower capacitor electrode; and the dielectric layer having a uniform thickness over the lower capacitor electrode and the insulation layer.

117. The semiconductor circuit of Claim 116, wherein the surface-modifying agent comprises a nitrogen-containing gas selected from the group consisting of trifluoronitride, nitrogen, ammonia, nitrous oxide, and nitric oxide.

118. A semiconductor circuit, comprising a capacitor;

the capacitor comprising a nitride dielectric layer interposed between a lower electrode and an upper electrode, the lower electrode formed in a container comprising an insulation layer and a top corner portion, a portion of the insulation layer being exposed at the top corner portion of the container, said exposed portion of the insulation layer implanted with a surface-modifying agent comprising an ionizable silicon species, whereby the surface-modifying agent provides for formation of a uniform thickness of a dielectric layer over the insulation layer and the lower capacitor electrode; and the dielectric layer having a uniform thickness over the lower capacitor electrode and the insulation layer.

119. The semiconductor circuit of Claim 118, wherein the surface-modifying agent comprises a silicon-containing gas selected from the group consisting of silicon tetrafluoride, silane, dichlorosilane, trichlorosilane, and silicon tetrachloride.

120. An integrated circuit, comprising:

an array of memory cells;

internal circuitry; and

at least one capacitor formed in a container and in electrical contact with an active area within a semiconductive substrate of the memory cell array, the capacitor comprising a nitride dielectric layer interposed between a lower electrode and an upper electrode, the lower electrode formed in a container comprising a nitride resistive material layer and a top corner portion, a portion of the a nitride resistive material layer being exposed at the top corner portion of the container, said exposed portion of the nitride resistive material layer comprising an implanted surface-modifying agent, whereby the surface-modifying agent provides for formation of a uniform thickness of a dielectric layer over the nitride resistive material layer and the lower capacitor electrode; and the dielectric layer having a uniform thickness over the lower capacitor electrode and the nitride resistive material layer.

121. The integrated circuit of Claim 120, wherein the surface-modifying agent comprises a nitrogen-containing gas selected from the group consisting of trifluoronitride, nitrogen, ammonia, nitrous oxide, and nitric oxide.

122. The integrated circuit of Claim 120, wherein the surface-modifying agent comprises a silicon-containing gas selected from the group consisting of silicon tetrafluoride, silane, dichlorosilane, trichlorosilane, and silicon tetrachloride.

123. The integrated circuit of Claim 120, wherein the nitride resistive material layer comprises an insulative material, and the lower electrode comprises a semiconductive material.

124. The intergrated circuit of Claim 120, wherein the nitride resistive material layer comprises an insulative material, and the lower electrode comprises a conductive material.